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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Technology 2024

**91363 Demonstrate understanding of sustainability
in design**

EXEMPLAR

Merit

TOTAL 05

Demonstrate Understanding of Sustainability in design - AS91363

1. INTRODUCTION TO SUSTAINABILITY

This essay involves **demonstrating an understanding of sustainability in design**. I'm looking at multiple components of sustainability in design, linking back to how this affects the **life cycle processes** and **pillars of sustainability**. This can also be used to show if the human race is currently sustainable, and what different design aspects affect sustainability.

Sustainability is a goal for the global population to create a long-existing environment that allows humans and Earth to co-exist for a long time. We aim to continue meeting the needs of our current generation, without compromising the ability for future generations to meet their own needs. The different components of sustainability consist of **social, economic, human and environmental**.

Human sustainability is focused on the health, well-being and structural organization of the human population. It is involved heavily in the employment sector, as it aims to increase employability, strengthen skill sets, and advance job satisfaction with the hopes of increasing a sense of belonging and enhancing the connection to life's purpose. While focusing on creating value within people, human sustainability targets both physical and mental health including; clean resources, healthcare services, societal pressures, community and effective government systems. It works to create a world with equality and fair justice, allowing for human life to flourish so future generations can thrive.

Social sustainability is similar to human sustainability and focuses largely on equality, inclusiveness and access to human rights, ensuring there is a fair distribution of resources. It focuses on preserving relationships between people and maintaining reciprocity within communities, cultures and globalization. It creates the substructure of the societies we live in, which is supported by laws, education, and equality. It aims to reduce social tensions and promote human rights, cultural diversity and education.

Economic sustainability is focused on improving the standard of living without disrupting the other components of sustainability, ensuring economic systems support long-term growth and stability - maintaining high quality and stable levels of economic activity, while preserving efficient and practical use of our resources. This sector focuses on efficient and effective use of

resources by reducing waste and reusing and recycling materials. This highlights the need for businesses to not be solely focused on profitability, but also take responsibility for social and environmental growth. Economic sustainability works to build economies that can withstand global challenges involving climate, finance and scarcity.

Environmental sustainability is about protecting natural environments and ecosystems that we rely on, aiming to improve human welfare. It is the main component focused on shielding our natural resources from depletion by creating responsible management to prevent irreversible damage. This involves addressing climate change, reducing carbon emissions, transferring to renewable energy, and adopting more sustainable agricultural practices, to preserve resources and biodiversity. Environmental sustainability works to improve the quality of life while minimizing the environmental impact, creating harmony between humans and the planet's ecosystem.

The four main pillars of sustainability - human, social, environmental and economic sustainability, work together to provide harmonic sustainability throughout people, communities, economies and the planet. All aspects are important in taking part in the preservation of our planet. These pillars are all vitally interconnected and without balance and equality between all, it impacts the planet's ability to achieve overall sustainability, risking our chance for a sustainable future. It is important to preserve our planet's health to maintain human life. Currently, I don't think our planet is maintaining positive levels of sustainability.

2. SUSTAINABILITY WITHIN DESIGN

Sustainability is an essential part of design as it's an important aspect in providing efficient production throughout raw materials, machinery, process, transport, packaging and excessive use of a material. It focuses on **resource efficiency and maintaining long-term ecological balance**, this involves prioritizing recyclability, eco-friendly materials, ethical production and fair labour practices. This encourages a **balance between design production processes and their contribution towards sustainability and environmental responsibility**.

Sustainable Materials:

The **materials** of a product control the overall impact of the **product's environmental footprint**, by choosing sustainable materials you choose resources that cause minimal harm to human life and the environment. Many types of materials achieve this while still accomplishing durability, renewability and recyclability. This includes materials that are **locally sourced, renewable, recycled, biodegradable, compostable and low impact, non-toxic materials**.



Renewable resources can regenerate quickly, they are derived from natural resources and reduce the dependency on non-renewable resources, however, they must be resourced responsibly to avoid disruptions to the ecosystem. Renewable resources include such as bamboo, cork, wool and organic cotton. **Recycled materials** such as reclaimed wood and recycled plastics or metal, help deflect waste from landfills and also decrease the amount of raw materials having to be extracted. This results in decreased demand for new materials as well as lowers the energy consumption used in production. **Biodegradable and compostable materials** further reduce waste in landfills and can return nutrients to the soil, bioplastics, hemp, and certain natural fibres break down naturally and are often used in packaging, disposable items and textiles. **Low-impact, non-toxic materials** are safe for both ecosystems and people, it reduces risks for negative impacts on human health and environmental quality. **Key factors should be considered** when deciding which sustainable materials should be used, this includes aspects like the **durability of the materials** - how long-lasting a material determines the length of the product's life, deciding how long in between replacements and therefore the level of consumption. **A material's full lifestyle and environmental impact** should also be considered, checking that it's ethically sourced, processed, transported, used and disposed of, including the consideration for fair labour conditions and respect for local communities and environmental sustainability.

An **example of a renewable material** is **soybeans** which are used in **soy-based materials**, they are renewable, versatile and grow relatively quickly when farmed sustainably, which provides a substitute for petroleum-based products. Soybeans are used in multiple different types of products, including foam used in mattresses and insulation, bio-plastics and food products. On the contrary, excessive extraction of soybeans has resulted in deforestation, especially in the Amazon rainforest, this means that farming of this material must remain responsible and sustainable to minimize environmental damage.

Environmental Concern + Impacts on Society

Designers have the control and ability to incorporate sustainable practices into their production to make a positive impact on society and minimize their environmental footprint. By choosing **renewable, non-toxic and durable materials** it promotes reduced energy use and cuts down waste and **environmental harm**.

How products are manufactured and designed can lead to issues such as pollution, poor work conditions and social inequalities. How products are designed is an important **aspect of health and safety**, poorly designed products can harm health and the environment due to exposure to **dangerous chemicals, toxins or unsafe materials**. For example, volatile organic compounds (VOCs) can be found in products like paints, cleaning supplies and building materials. VOCs release into the air creating indoor air pollution, this can cause health problems and may lead to more serious issues. The design choices and manufacturing process also have a huge impact on sustainability and the environmental footprint, the materials used in production have to be **extracted from natural resources and ecosystems**, which can cause damage to the environment if not extracted properly or sustainably. Factories used during manufacturing also



release **carbon emissions** into the atmosphere from fossil fuels, this contributes to air pollution and **climate change**, possibly causing further social tensions and increasing the harm caused to our planet's environment. **If products aren't designed with durability**, making them unable to remain long-lasting, it increases the amount of waste going into landfills, plus adding on **further consumption** when new products have to be bought more often - this **increases the amount of resources needed**, and carbon emissions released during production. **Practicing more sustainable production and use of materials cuts** down on pollution and carbon emissions, conserves resources and minimizes waste. It encourages more **efficient use of resources** and can lead to the production of more sustainable, new products and technologies. Socially, this **raises consumer awareness**, promotes social responsibility, also reduces costs, overall benefitting both the environment and society.

3. LIFE CYCLE OF A PRODUCT

The life cycle of a product consists of 5 stages; material extraction, manufacturing, distribution, use and disposal. Understanding these stages is essential when evaluating the environmental impacts of a product's lifestyle, including any environmental footprint they may leave. The life cycle of a product contributes to the design practices focused on increasing sustainability within design.

- **Raw Material Extraction:**

This is the first stage of a product life cycle, which involves the **sourcing of raw materials**, it is important to consider the process and quantity of materials during extraction to avoid excessive environmental harm. Extracting materials from the Earth could lead to **resource depletion, destruction of land/habitats, and pollution**, it contributes to the emptying of the planet's finite resources. In design, **choosing sustainable materials** that are recyclable, reusable and/or durable, **minimizes the reliance on non-renewable resources**, as well as the use of toxic chemicals.

- **Manufacturing:**

This stage transforms the raw materials into finished products which can be used by consumers. This process involves a lot of **machinery, factories and development facilities**, which produce a large amount of energy and water use, carbon emissions and waste generation - **contributing to global warming and pollution**. Changing production processes to use more energy-efficient appliances and renewable energy sources, and reducing waste can decrease the impact that manufacturing has on the environment. Designers could also make a positive impact by opting to **create simpler designs that require less materials** and manufacturing.

- **Distribution and Transportation:**

This stage involves the process of **transporting the products to consumers or wholesalers**. This transport involves the use of vehicles such as large trucks, planes and boats which contribute heavily to the **production of carbon emissions and air pollution**, not to mention the **additional packaging** which **generates excessive waste**. By **sourcing locally** and using **sustainable packaging**, designers can **minimize the environmental burden**. This also reiterated the importance of producing more lightweight, simple designs as the large, complicated products use up more resources.

- **Product Use:**

How the product is used can differ based on the purpose and type of product it is. Some products like electronics and appliances use up **large amounts of energy**, while other products require water, chemicals, regular maintenance, etc. All use of products continues to impact the environment, therefore, the **designing of resource-efficient products is essential to reduce environmental impacts**. Extending the lifespan of products by increasing their durability and repairability **reduces the need for replacement** and therefore reduces their environmental impacts.

- **End-of-Life (Disposal or Recycling)**

Once the product comes to the end of its useful life, it needs to be disposed of or recycled. Disposal **adds to landfills, increasing pollution** and the amount of waste being generated. Valuable resources also may be lost if the **disposal process isn't efficient and responsibly managed**. Toxic materials and non-biodegradable materials cause extra harm and degradation towards the environment. Designers are continuously **adopting new ways** in which products can become **recyclable, reused or repaired**. It is also important they make products easy to disassemble and use the right materials to reduce landfill waste.

In conclusion, analyzing the life cycle of products allows designers to **make informed choices** that enhance sustainability. By understanding how materials, energy, and waste interact throughout a product's life, sustainable design can create products that **minimize environmental harm and contribute to a healthier planet**.

4. MICRO AND MACRO SUSTAINABILITY

Micro and macro sustainability are two different levels of sustainability, but both link together with each other.


Micro sustainability is sustainability on a smaller scale, it focuses on the details and more personal changes that can be made. It focuses on aspects like **waste within households**; reducing energy usage at home, choosing reusable materials like shopping bags and containers, using recycled products and overall practicing sustainable habits. It encourages communities to live more sustainably and make more environmentally friendly choices, micro sustainability is less likely to make a large impact on the environment in comparison to macro sustainability. Designers can create products relating to micro sustainability that promote







environmentally friendly habits, this includes reusable bags, coffee cups, water bottles and energy-efficient appliances.

Macro sustainability addresses much larger environmental issues like **climate change, social equity and resource depletion**. This could get involved with governments including political policies and economic systems. Macro sustainability includes the **entire life cycle of a product** and uses this to discover how to create as little waste as possible, this impacts the total amount of waste produced in the world and within landfills.

5. POLYHALITE MINE

The  **Polyhalite mine**, set to go into production in 2027, will be Britain's first large-scale mine in decades, becoming the highest-grade polyhalite mine in the world and **generating over 2000 jobs**. It will be based in the North York Moors National Park, located in Yorkshire, England. The design of the mine ensures a minimalistic impact, meaning the actual mine is nearly invisible from the surface as most **machinery and buildings are found underground**. This makes it now the deepest mine in Europe, with a depth of 1.5km. Polyhalite was surprisingly found in Whitby by

accident by oil prospectors in the 1930's. Here, nearly 3 billion tonnes of this resource was found which supplied the mine with a lifespan of 100 years, while still having 290 million tonnes of polyhalite remaining. The UK could **make use of specialization** due to the fact polyhalite is only found in this location, where the processing and transportation of this mineral is easily accessible and achievable. The UK economy has the possibility of **gaining 100 billion pounds** into the economy over the next 50 years. Polyhalite is a 'fancy' type of potash, made up of 4/6 essential nutrients that plant life needs to grow, this includes potassium, magnesium, sulphur and calcium. **It is a potassium-rich salt-based mineral and is commonly used as fertilizer all over the world**. Under the name  it can be marketed as multi nutrient, low chloride, ultra-low carbon fertilizer, certified for organic use that can **increase crop yields as well as improve and protect soil conditions**. When compared to the two most commonly used potassium fertilizers,  **produces 93% less carbon dioxide** than sulfate of potash, and 85% less than muriate of potash. The  mine works as a great example to show that an **innovative approach to environmental protection**, and commitment to producing a more sustainable material  will contribute to more environmentally friendly manufacturing and products. This mine also contains a conveyor belt to help minimize the gas used when trucks transport materials. Overall, this mine shows the **positive effects of when sustainable practices are applied to new economic and environmental developments** and how this will benefit the extraction of the material as well as the lifestyle of products.

6. MINE



The [redacted] mine (or [redacted] Mine) is located in the south-west of West in Cumbria, UK. This is an underground mine made to collect **metallurgical coal** which is an essential ingredient needed for **steel making**, both in the UK and worldwide. However, this is a controversial project as the mine has many concerns about its climate impact. The UK was supposed to **cut 78% of its greenhouse gas emissions by 2035** and the Cumbria mine is predicted to increase carbon emissions and double emissions of natural gas. Even though supporters of this mine have claimed it could increase local economic growth and job opportunities, the project's **approval was suspended** in early 2021, ahead of the COP26 climate conference in Glasgow. This decision highlights the **failures of developed nations in keeping their climate pledges**. To go further into the UK's coal production, it takes around **770 kg of coal to make one tonne of steel**, meaning nearly 80% of steel is made up of coal. The **steel industry was responsible for 2.7% of UK emissions** and coal is one of the most polluting fossil fuels. Overall, this mine's operations raise concerns about its impact on local ecosystems, air quality and water resources. Creating long-term challenges with sustainability and the UK's climate goals.

7. INTERNATIONAL AND ECONOMIC SUSTAINABILITY

By adopting sustainable practices we ensure the equipment and resources we require to improve and simplify our life are available to future generations. This is crucial when enjoying our current benefits and also keeping in mind future well-being and standard of living.

China:

For years, many international investments have been put into China to improve their economic system, since **China is a huge sector of the world economy**. Overseas countries have invested in China's production of capital goods; improving technology to increase the production of consumer goods, in exchange, China exports these consumer goods internationally. **With a declining birth rate and a decrease in younger populations**, China will eventually struggle to find people available for labour. We can begin to see this issue now, this **reshapes China's role and dominance in the world economy**. China has a large output of Real GDP, a sign of economic strength, with continuous advances in technology and services. As **production shifts to higher-value sectors**, the global supply chain faces disruptions and inefficiencies. Additionally, environmental concerns arise from rapid urbanization and industrial activity, impacting global sustainability efforts. The changing dynamics in China **highlight the need for more resilient and sustainable economic practices** worldwide. Rethinking global supply chains and investing in sustainable technologies can help address these challenges and **promote long-term economic and environmental stability**.

Russia Vs. Ukraine:

Since Russia invaded Ukraine the sustainability of our global economy and immigration system has been drastically impacted. The global economy has been affected heavily by an increase in prices for energy and oil that is usually supplied by Russia. Since 1992, the export of Russian oil has kept the price of petrol (diesel) low, within the event of the Russia Vs. Ukraine war, **oil prices have increased**, therefore **increasing the price of petroleum worldwide**.



Europe also relies heavily on natural gasses from Russia, however, have recently had to resort to **investing in renewables or finding alternative energy sources**. Ukraine has the resources, ability and power to destroy Russia's oil infrastructure and remove their income, however, this would increase oil prices worldwide having a huge impact on economic growth and increasing inflationary pressures, resulting in significant economic consequences. Russia **creates their oil** and uses it to create exporting businesses to **create its sustainable future**.

8. CASE STUDY - FOOD INDUSTRY

██████████ is a very **large American-owned confectionery company** based in Chicago, it produces foods, snacks and beverages - operating in around **160 countries**, generating around **\$26.5 billion in revenue annually**. Between all of the development facilities including all factories, offices, research and distribution - ██████████ **houses over 91,000 employees**. ██████████ practices sustainable production as they assure customers of high-quality products, as well as sustainable ingredients and packaging. ██████████ has a **sustainability framework and well-being strategy** called “██████████”, focusing on creating the ██████████. Meaning their products are made with **good quality materials, safe working conditions, and focus on mindful and sustainable snacking**. ██████████ has multiple policies and regulations they use to ensure their company remains ethically led, to not compromise the promises they've made to their customers. Their **sustainable snacking goal** includes many different aspects focusing on different components in this company, as well as different parts of the **life cycle of products**, this reassures customers that Mondelez is considering everything when manufacturing and distributing their products.

██████████ runs a program within ██████████ called ██████████, an initiative program focused on **using sustainably sourced cocoa**. ██████████ initially invested US\$1 billion into this program when it started up in 2012 and has now been integrated into communities from **9 different countries involved in cocoa production**; Ghana, Côte d'Ivoire, Indonesia, India, the Dominican Republic, Brazil, Nigeria, Cameroon and Ecuador. Cocoa is very delicate and sensitive and therefore reacts easily to certain climates. Cocoa production requires a specific type of climate that is only available 20 degrees south or north of the equator, meaning the **countries that are capable of producing cocoa need to be protected**. 90% of the world's cocoa farms are family-run and have less than 5 acres of land, ██████████ works to improve these farms by **ridding them of low productivity, low farmer incomes and limited development**. ██████████ has set salient sustainability goals throughout its development journey. This includes reaching 200,000 farmers and one million community members by 2022. They then reached a further 243,000 farmers and 3200 communities before the end of 2023 and got 85% of ██████████'s chocolate brands sourced through ██████████. **By 2025, ██████████ aims to source 100% of cocoa volume for their chocolate brands from ██████████** as well as cover 100% of ██████████ communities in West Africa with a **Child Labor Monitoring & Remediation System (CLMRS)**. In June 2020, ██████████ announced its **switch to 100% renewable energy** in two of their Melbourne factories, this **prevented nearly**



40,000 tonnes of carbon from entering the atmosphere every year. Across [REDACTED] five Australian factories, carbon footprint caused by electricity used, **decreased by 80% due to their investment in renewables.**

“At [REDACTED] we measure and externally verify our impact on farmers and communities to learn and enhance our program. By evaluating our progress and impact, we can better understand the issues in cocoa, continually assess our work, as well as share insights with sector partners to help drive more sustainable change.”

Not only does [REDACTED] work to **manufacture sustainable, high-quality products**, but they also promise to maintain sustainable, **recyclable packaging**. Their goals are to **reduce packaging, evolve packaging** and **improve systems** and infrastructure. In terms of **reducing packaging**, the focus is to reduce the amount of virgin plastic found in packaging materials by increasing the use of new materials and recycled content. [REDACTED] has **cut down on 2.3% of plastic in packaging** from 2020. Currently, they are on track to reach their **2025 goal** - a 5% decrease in

the use of plastic in all packaging. The **Ellie MacArthur Foundation** is a foundation that focuses on reducing the use of plastic within economies, out of the **123 companies** included in their **Global Commitment Progress Report**, [REDACTED] was the company chosen that reported reducing the highest amount of plastic within their packaging - over **12,000 metric tonnes**. By **evolving packaging**, [REDACTED] works to produce its packaging with **96% recyclable material** by the end of this year. Earlier this year, [REDACTED] became a member of the **Ocean Plastic Leadership Network (OPLN)**, a global community dedicated to ridding the oceans of plastic pollution - in which [REDACTED] has worked side by side in order to produce responsible guidelines to be followed during production to ensure progressive recycling.

[REDACTED] is also involved in the **UN treaty for plastic pollution** via the business coalition, playing an active role in the **EMF and World Wildlife Fund (WWF)**. These groups work to improve on policy development, aiming to reinforce regulations on **reduction, circulation and prevention**.

9. CONCLUSION

In conclusion, my thorough research has led me to learn in-depth about the four pillars of sustainability and the different components of each aspect. Human, social, environmental and economic sustainability integrate to create solutions to generate a long-lasting environmental system. These pillars mainly focus on preserving resources, materials, and land and reducing



waste while integrating into the design by manufacturing products involved in sustainable solutions.

I have researched more about how sustainability is incorporated into design, and this relates to me and the manufacturing of my product, this is an example of micro sustainability. I learnt about renewable materials, environmental concerns and the impact on society. Designers have the power to reduce environmental footprints caused by products by choosing the right materials, resources and ethical production practices. Designers are responsible for controlling the life cycle of a product to ensure all aspects consider the environmental impact it causes. This approach will lead to the result of eco-friendly products to ensure long-term ecological benefits, helping the human population and the planet. The life cycle of a product is a detailed 5 step process, beginning from the extracting of the materials to the disposal of the product. It involves many essential steps and is important in ensuring products are supplied within the economy to increase/maintain the quality of life. However, each step of this process contributes heavily to the pollution and destruction of the planet's ecosystem, highlighting the severe importance of sustainable practices to be incorporated into this process. Designers can do this by minimizing the size and detail of their products, the materials being used, the workspace environments and the distance different products have to travel.

I researched two large mines - the [REDACTED] Polyhalite Mine and the [REDACTED] Mine. The [REDACTED] mine is a new mine that has many economic and environmental benefits, not only within the mine but also the polyhalite it's producing. This is a new, innovative way of changing the manufacturing process and the material being produced while positively contributing to sustainable solutions, without impacting economic activity and the quality of life. The [REDACTED] mine has yet to be manufactured, however, has been delayed due to its worrying climate concerns. This mine has many issues with it that negatively impact the environment, including the material it's producing - coal. This will involve excessive steel production which may benefit the UK's economy but will cause severe harm to the environment.

I conveyed a case study on a large company within the food industry, producing large amounts of snack foods, beverages, confectionery and more - [REDACTED]. I completed research on the policies they use to maintain a sustainable company. [REDACTED] is committed to producing environmentally friendly products, including taking care of their workspaces, employees, and the entire life cycle of products. [REDACTED] has many policies, I mainly focused on their [REDACTED] and program called "[REDACTED]", these are focused on sustainability and producing eco-friendly products. Currently, [REDACTED] policies and programs are very successful in achieving their sustainability goals, and [REDACTED] is a great example of a large international company that incorporates sustainability into the design and manufacturing of its products.

<https://www.mondelezinternational.com/snacking-made-right/packaging-innovation/>

<https://www.cocoalife.org>



<https://www.westcumbriamining.com>

<https://uk.angloamerican.com/the-woodsmith-project>

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<https://www.ellenmacarthurfoundation.org/>

<https://sustainablepackaging.org/>

<https://sdgs.un.org/>

<https://www.worldwildlife.org/>

<https://www.sustainablematerials.co/lander>

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Merit

Subject: Technology

Standard: 91363

Total score: 05

Q	Grade score	Marker commentary
One	M5	The candidate effectively defined the three pillars of sustainability, showcasing a solid understanding of their interconnections. Through a case study, they identified key areas for intervention and highlighted significant innovations. They also discussed the compromises and priorities inherent in sustainable practices.